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ABSTRACT

The ancient sport of archery is particularly appropriate for physical education in the space age. It is a projectile sport: in order to hit the gold, the archer must use many of the principles that scientists used in putting men on the moon. Since 1972, when the United States team returned from the Summer Olympic Games with two gold medals in target archery, the sport has become increasingly popular with Americans of all ages and physical capabilites, including the handicapped. Because it requires close coordination between the eyes and back, shoulder, arm, hand, and finger muscles, archery is considered an important rehabilitation activity for paraplegics and is one of the major events in the National Wheelchair Games. "Teaching Archery" is the first in a series of curriculum guides for group instruction in leisure time activity. This curriculum guide is divided into four major sections. Section 1 discusses facilities and guidelines for selecting and/or making equipment. Section 2, entitled "Teaching and Learning," outlines the preliminaries, a suggested six-session plan of instruction, strategies for group teaching, problem diagnosis and prescription, quick analogy teaching cues, assessment and evaluation, crossdisciplinary activities, and extra class opportunities. Section 3 contains a glossary of terms, and section 4 lists selected resource materials. (JMK)

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TEACHING ARCHERY

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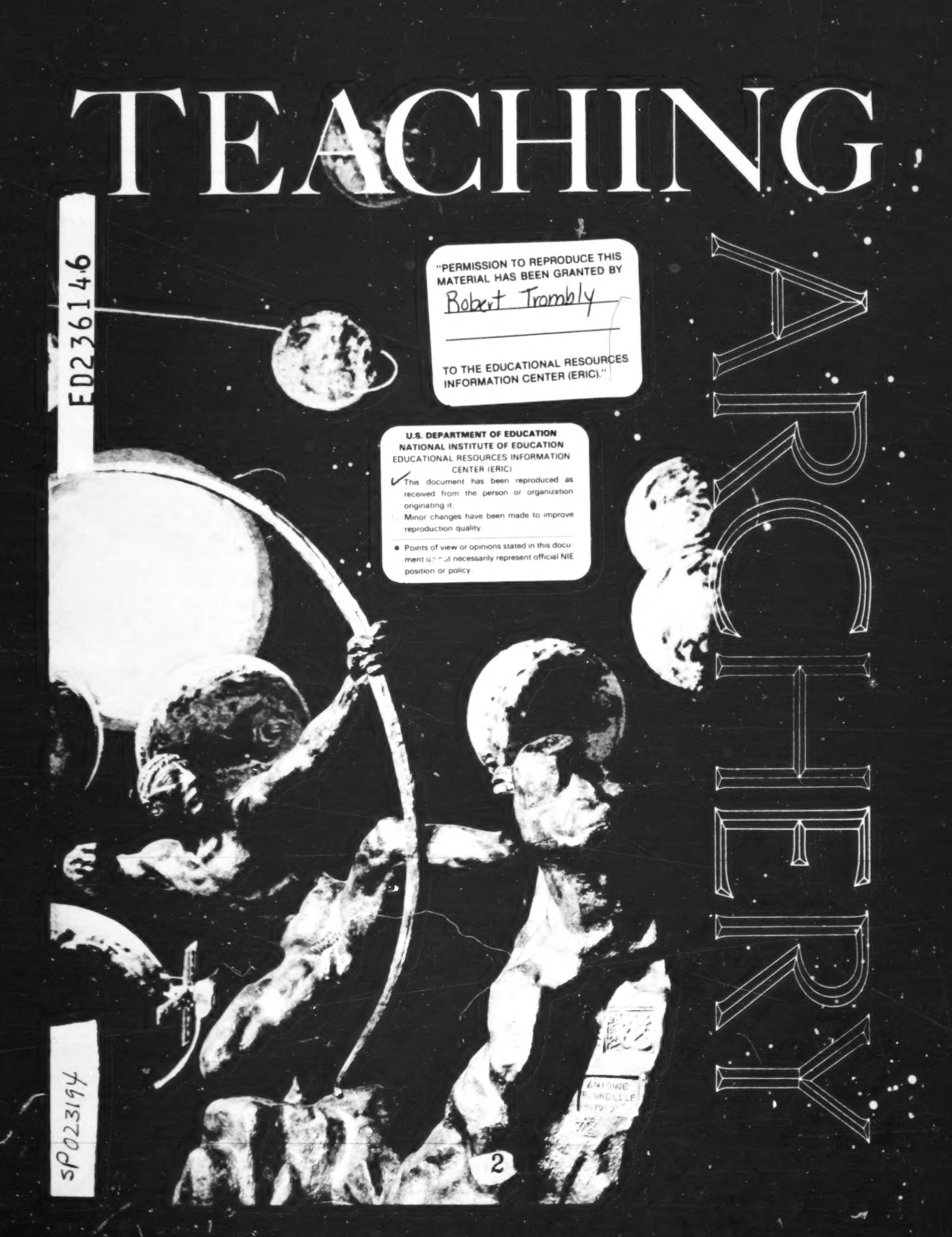

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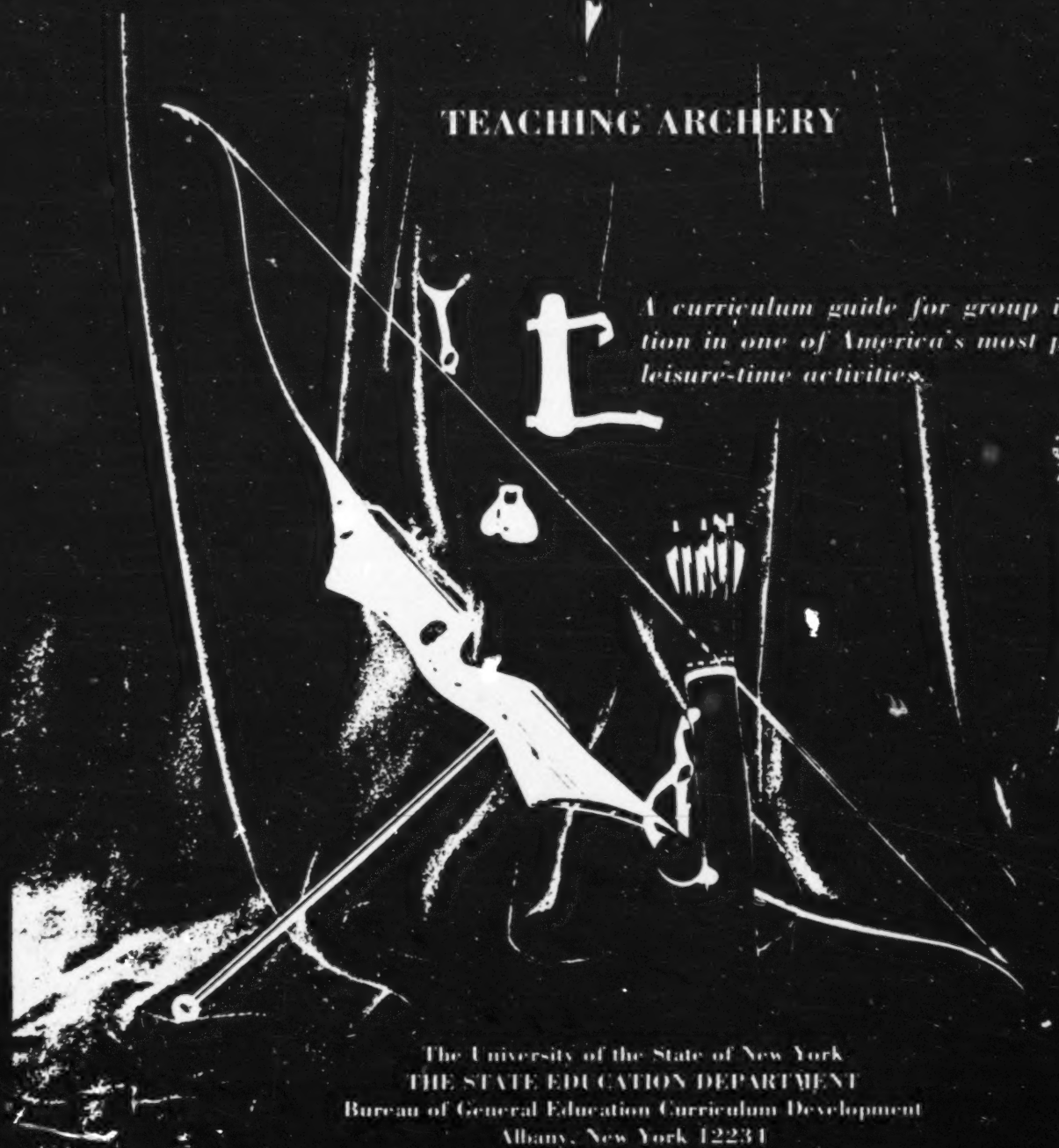
TEACHING ARCHERY

A curriculum guide for group instruction in one of America's most popular leisure-time activities.



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FOREWORD

Teaching Archery is the first in a series of curriculum guides for group instruction in leisuretime activity. Suggested by William F. Straub, professor of physical education at Ithaca College and president of the New York State Lifetime Sports Association, the series is being developed by the New York State Education Department in cooperation with the Association as a means of infusing the concepts and practices of leisuretime activity into the ongoing physical education program in schools throughout the State. The project is under the supervision of Bernard W. Hungerford, associate in physical education and recreation at the New York State Education Department and an active member of the New York State Lifetime Sports Association.

The manuscript for this publication was written by Lura Wilson, vice-president of the board of governors of the National Archery Association. Mrs. Wilson is particularly well qualified for the job, having been New York State Archery Champion five times; National Clout Champion four times; coach for three National intermediate archery champions, 17 National intermediate archery team champions, and 25 New York State individual and team champions; instructor/trainer for certified archery instructors' courses; codirector of the World Archery Center (formerly Teela Wooket Archery Camp); author of several articles for the *Journal of Health, Physical Education and Recreation*, the NAGWS (National Association for Girls and Women in Sport) *Archery Guide*, and *The Woman Coach;* and an honorary member of the Association for Women in Physical Education in New York State.

The material for *Teaching Archery* was reviewed by the following members of the New York State Lifetime Sports Association and/or the New York State Education Department: G. Hal Chase, director of health and physical education at the State University College at Oneonta; Joseph Famellette, professor of physical education at Rockland County Community College and a member of the professional staff at the New City Racquet Club; George H. Grover and Gerald J. Hase, associates in physical education and recreation at the New York State Education Department; Mr. Hungerford; Luke LaPorta, director of health, physical education, and recreation at Liverpool Central School; Donald O. Lindell, associate in physical education and recreation; Bea Massman, editor of *Badminton, U.S.A.;* John P. Rentz, Irwin Rosenstein, and Joanne Sculli, associates in physical education and recreation; Mr. Straub; and John Whelan, assistant professor of physical education at Bronx Community College.

The following people should also be recognized for specific contributions to the document: Lois Catherine Hoover, a teacher at Walton Central School, for her hand-drawn illustrations; Kenneth W. Hoare, for the cover design and other graphic art work; James Kukowski of the audiovisuals unit of the National Aeronautics and Space Administration, for the artists' drawings used on the cover; Mary V. Kelly of King Features Syndicate, Inc., for permission to use the two cartoons from *Hagar the Horrible;* Richard Switzer, headmaster of the Human Resources School in Albertson, Long Island, for the photographs of wheelchair archers; Ernest Andrew Mills and James V. Gilliland,

associates in art education, for their review of the crossdisciplinary activities in art; Hillis K. Idleman, author of *Contemporary Consumer Education* (McGraw-Hill Book Company), for developing the consumer education activities; Barry W. Jamason, associate in continuing education curriculum development, and H. Wayne Trimm, art director for *The Conservationist*, for their contributions to the crossdisciplinary activities in environmental education; Arthur J. Dudley, chief of the Bureau of Industrial Arts Education, for his suggestions in this area; Aaron L. Buchman, associate in mathematics education, for his help with the section on math; Edward T. Lalor, chief of the Bureau of Science Education, William Atherton, supervisor of science for Niskayuna Central School, Earle Cleaves, science teacher at Bethlehem Central School, and John Fitzgibbons, physics teacher at Cazenovia Central School, for their work with the crossdisciplinary activities in science education; and Rita A. Sator, associate in secondary curriculum, for coordinating the development of the publication and preparing it for press.

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INTRODUCTION

The ancient sport of archery is particularly appropriate for physical education in the space age. It is a projectile sport: in order to hit the gold, the archer must use many of the principles that scientists used in putting men on the moon and the Viking on Mars. Like our space shots, archery can be a team effort; but it has the added dimension of personal achievement, for the archer performs the entire operation from identifying the goal to analyzing the results as an individual competitor against the elements, other archers, live game, or himself/herself.

Since 1972, when the United States team returned from the Summer Olympic Games with two gold medals in target archery, the sport has become increasingly popular with Americans of all ages — including the handicapped. Elementary school boys and girls are as interested as young adults and senior citizens, and often compete in the same tournaments. Because it requires close coordination between the eyes and back, shoulder, arm, hand, and finger muscles, archery is considered an important rehabilitation activity for paraplegics and is one of the major events in the National Wheelchair Games. Target archery, clout shooting, flight shooting, field archery, and such games or novelty events as archery golf, balloon pops, and tic-tac-toe can therefore be found in schools and summer camps throughout the country. Bowhunting is also on the rise. Every year, nearly four million people in the United States and Canada hunt with bows and arrows or compete in archery tournaments.

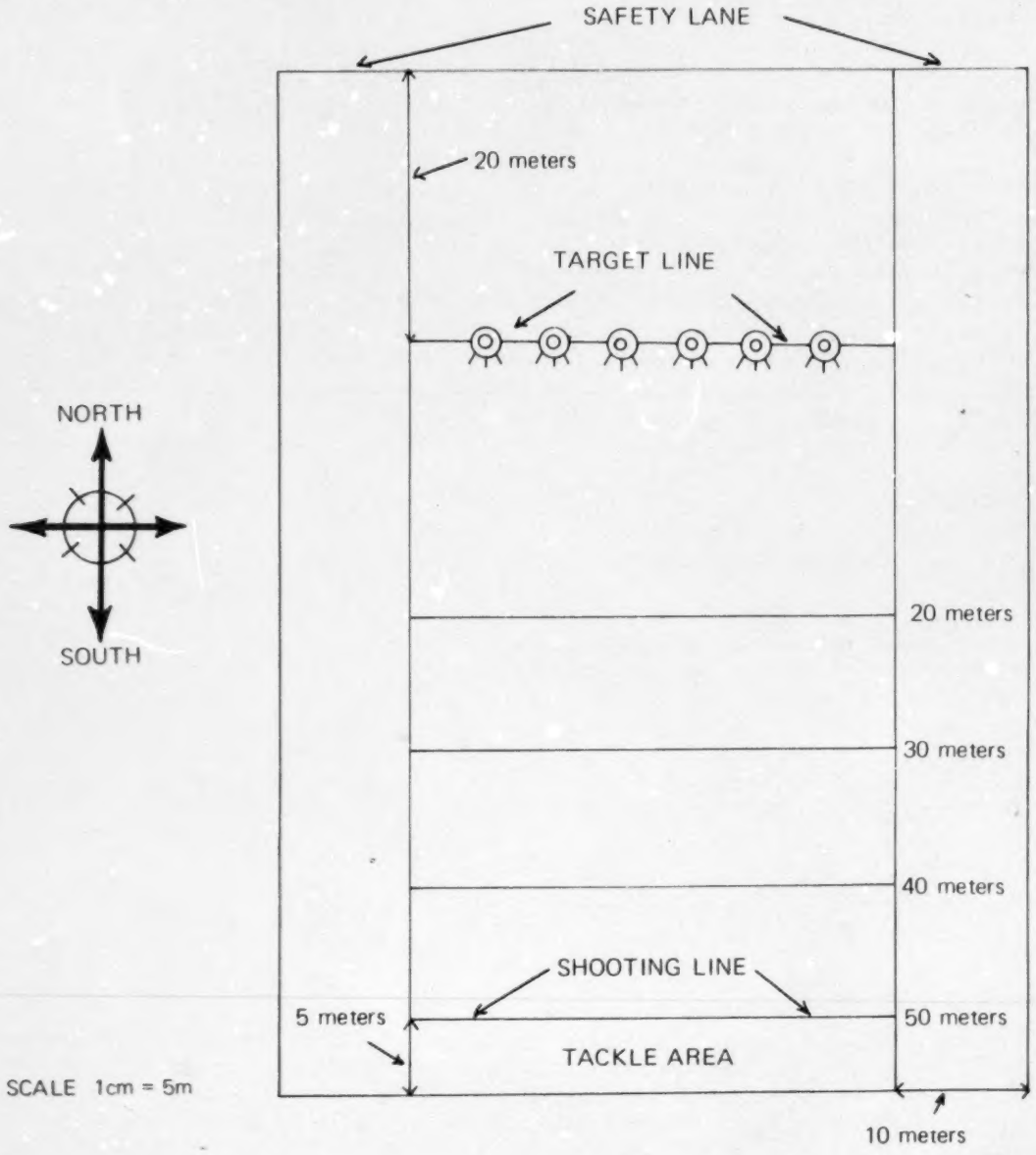
Recognizing a good market, equipment manufacturers are attempting to develop quality tackle at reasonable prices and are working with the National Archery Association (NAA) and the Professional Archery Association (PAA) to see that NAA instructors' courses are given in all parts of the United States. At least one of these has packets of equipment for lease or rent to education groups and institutions. This is a valuable service, for it provides an opportunity to experiment with programs in archery, determine the level of student interest in the sport, and define specific needs and resources before a major financial commitment is required.

FACILITIES AND EQUIPMENT

In planning an archery program, physical education teachers should give serious consideration to the facilities they will be using. Will instruction be given outdoors, indoors, or in both places? How large are the classes likely to be? Can they be accommodated in the space(s) available? If some of the classes are too large, would it be possible to divide them so that smaller groups can take archery while the rest of the class participates in other forms of activity? Some schools offer archery and badminton at the same time, thus reducing the size of the group for either sport. In any case, the following recommendations might be helpful.

FACILITIES

An outdoor program should have an archery range laid out on a grassy field in a north/south direction so that student archers will not have the sun in their eyes while shooting, regardless of the time of day. The range should look like this:



- The tackle area is a 5-meter space behind the shooting line, where bows and other equipment are placed when not in use and where the archers stand while waiting to shoot or retrieve their arrows.
- The shooting line is the place where the archers stand while shooting. Ideally, the line should be located on the south end of the range. It is equal in length to the target line.

- The shooting area is the space between the shooting line and the targets. The area should be at least 30 meters in length. Forty to 50 meters is preferable, however, because the students will probably be shooting this far from the targets by the end of the season and these dimensions are required for varsity tournaments.

- The target line is the series of spots where the targets are placed. Ideally, the target line should be at the north end of the range. Its length depends upon the number of targets to be used; and this, in turn, determines the width of the shooting area and the length of the shooting line. The targets should be placed 4 to 4 1/2 meters apart from center to center in order to provide sufficient shooting space to accommodate four, even six, archers per target without crowding.

- The target backstop is a 3-meter embankment or nylon net located 9 meters or so behind the targets to catch any arrows that miss the matt.

- The safety lanes are 10-meter spaces on either side of the shooting area which are off-limits to everyone when the archers are shooting — *or preparing to shoot.*

An indoor program also requires an archery range. In this case, the shooting area should be at least 18 meters long, with a net or backstop of some sort about 2 meters behind the target line and another 2 meters of clear space behind the backstop. The width of the shooting area depends upon the amount of space available. Two meters from one target center to another is acceptable if only two people shoot at a time.

EQUIPMENT

Completely outfitting a class of 24 students in a brand new secondary school program with the best and most durable equipment will cost about $2,500. If elementary school children are to be included — and articulated coeducational programs for pupils from age 7 or 8 to adult are strongly recommended — the initial cost will be higher. Assistive devices (bow slings, wheelchair bowstringers, telescopic sights, etc.) will also increase the cost. A basic rule in selecting equipment is to make sure that it is (1) durable and (2) properly fitted to the archer. There are a few money-saving options:

- Tackle might be rented rather than purchased for the first year or two, or some purchased and the rest rented.

- "Take-down" bows are a possibility. More expensive per unit than regular bows, they are less expensive in the long run because they consist of a standard handle into which limbs of different weights can be fitted, thus providing greater flexibility for the program while reducing its cost.

- Moulded glass bows and wooden arrows might be used instead of the higher quality but more expensive laminated bows and fiberglass arrows.

- Bow racks, target stands, wheelchair bowstringers, amputee archery assists, storage equipment, etc., could be made by industrial arts classes.

- The school program might be coordinated with existing community programs, or an effort made to develop a coordinated program of this type.

If tackle is either borrowed or leased, or if moulded bows and wooden arrows are used for class instruction, it is advisable to purchase at least three laminated recurve bows and 3 dozen fiberglass arrows each year for tournament shooters. In this way, a stock of high quality equipment will be accumulated over the years (if it is properly used and stored) and the program will prosper.

GUIDELINES for SELECTING and/or MAKING EQUIPMENT

Bows

Bows are identified by type, construction and material, weight (or draw weight), and length.

- There are two basic types: the straight or straight-limb bow, a descendant of the old English longbow; and the recurve bow, which has a Turkish look because the tips bend forward either sharply, in a static recurve, or long and flexibly, in a working recurve. The latter is highly recommended because the design adds leverage to the bow, thereby increasing the amount of force it can apply to the arrow.

- Bows are made of flexible woods (in which case it is important to note whether the curve of the bow follows the grain of the wood); a fiberglass and resin mixture known as fiberglass reinforced plastic; and a variety of backing materials such as baleen, rawhide, silk, sinew, and thin strips of tougher woods, like hickory and bamboo. Depending upon the choice of material and the method of construction, they are variously called composite, backed, or laminated bows. In general, laminated bows are the best choice for school programs because they are stable, strong, and durable.

- The weight of a bow is the amount of force (expressed in pounds or kilograms) required to pull or draw a 28-inch (71-centimeter) arrow to its full length. This draw weight increases or decreases about 2 pounds for every inch (357 grams per centimeter) the bow is drawn for arrows that are longer or shorter than the 28-inch (71-centimeter) standard. Thus, a 20-pound (9-kilogram) bow drawn 24 inches (61 cm.) has a draw weight of approximately 12 pounds (5.4 kg.). Bows vary from 15 to 30 pounds (approx. 7 to 14 kg.) in draw weight. A good

rule of thumb is to equip beginning archers with lighter weight bows until they become accustomed to the *feel* of the tackle and can handle it properly, for students who are overbowed tend to hunch the left shoulder and become discouraged when success eludes them. Once they are comfortable with the equipment, they can begin to use heavier bows within the appropriate range in the following table:

Young children	10 to 15 lbs.	(4.5 to 6.8 kg.)
Ten- to 12-year-olds	15 to 20 lbs.	(6.8 to 9 kg.)
Teenage girls and women	20 to 30 lbs.	(9 to 13.6 kg.)
Teenage boys and men	25 to 40 lbs.	(11.3 to 18 kg.)

It is advisable to buy an inexpensive set of very light (7- to 12-pound, 3- to 5-kilogram) bows that can be strung with twine and used for practicing the draw. If the class is large and the shooting space and/or equipment limited, these smaller bows can do much to keep the students interested while waiting to shoot.

- Bows vary in length from 48 to more than 72 inches (122 to 183 cm.) and should be appropriate to the size of the students who will be using them. In general, however, 48-inch (122-centimeter) bows are recommended for wheelchair archers, and 66-inch (168-centimeter) bows are a wise investment for tournament programs because they can be used efficiently by either boys or girls.

Other helpful hints include the following:

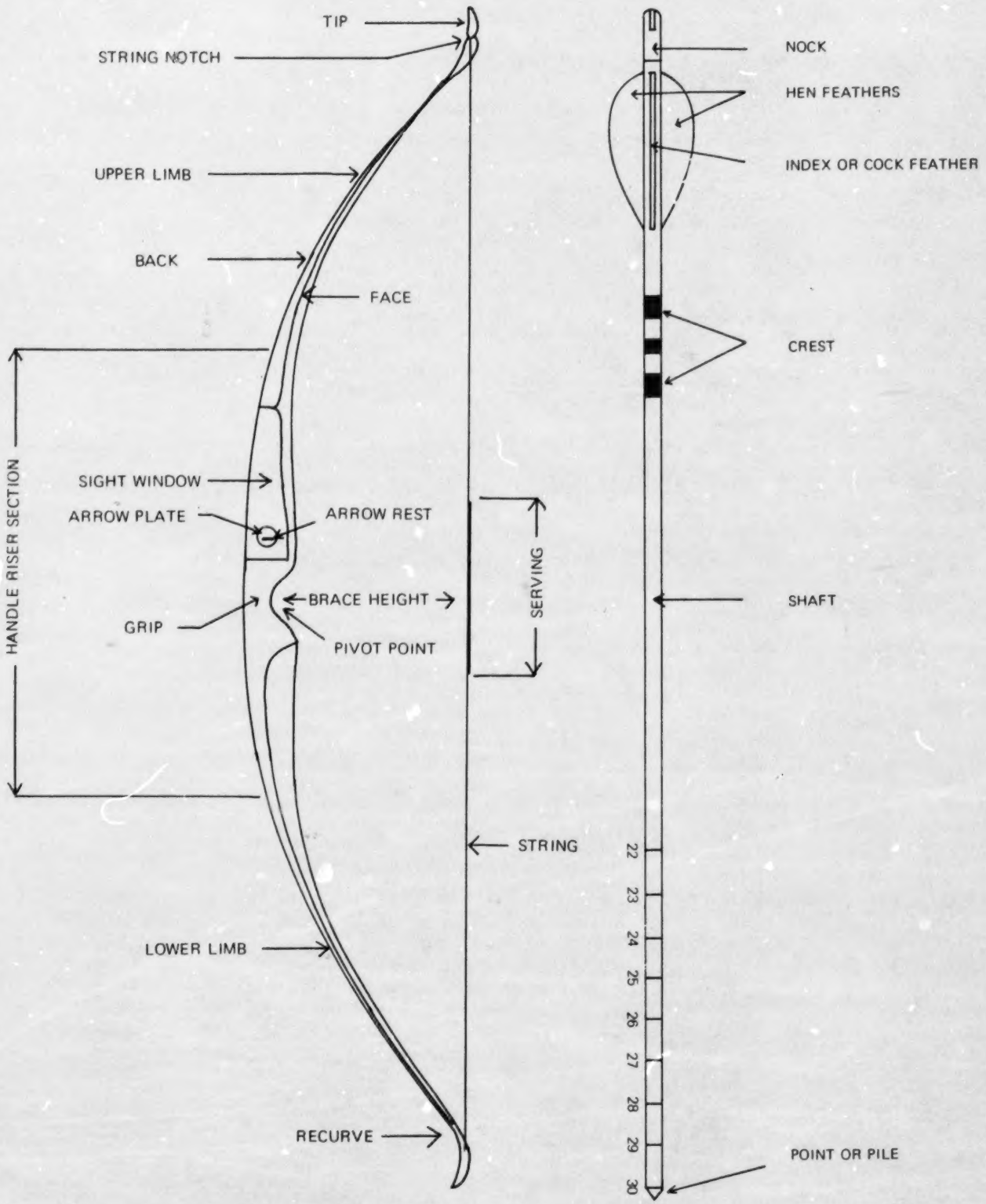
(1) The bow should bend evenly all the way from the handle to either tip when it is drawn, and return to its original shape with a minimum of "following the string" when it is unstrung.

(2) If the bow has a sight window, both a right-hand and a left-hand model should be purchased.

(3) If the bow doesn't have an arrow rest, it is advisable to buy one. A flexible plastic rest on an adhesive strip is recommended for all-weather use.

(4) If the string on the bow is made of hemp, it should be replaced with one made of dacron. Eight- or 10-strand double-loop dacron strings are best, because they are light yet durable and heavier strings will slow the arrow down too much. Since regularly used strings seldom last more than a season, it is advisable to order enough to replace the string on every bow every year.

(5) Once the bows have been purchased, they should be maintained in proper working order. For example, when not in use, they should be unstrung and placed on a rack or hung from pegs in an even-temperature, low-humidity setting where they will neither warp nor crack.


TIP
STRING NOTCH
UPPER LIMB
BACK
FACE
HANDLE RISER SECTION
SIGHT WINDOW
ARROW PLATE
ARROW REST
BRACE HEIGHT
GRIP
PIVOT POINT
SERVING
STRING
LOWER LIMB
RECURVE
NOCK
HEN FEATHERS
INDEX OR COCK FEATHER
CREST
SHAFT
22
23
24
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26
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29
30
POINT OR PILE

13

Arrows

Since arrows are subject to more abuse than any other piece of archery equipment, it is advisable to buy several sets of the type and quality that seem most appropriate for the uses to which they will be put.

- For children and other beginners, arrows made of wood are sufficient — if selected with care. They are also good for field shooting and bowhunting. Cedar arrows are best because of their inherent stability, shooting quality, and availability in a range of grades and prices. Birch arrows should be avoided: they are very inexpensive, but warp so badly they look like snakes after one day of use.

- Arrows made of fiberglass are recommended for class and general team work because they are almost indestructible, hold their shape in spite of dampness, and are less expensive than aluminum arrows. They lack some of the shooting quality of metal arrows, but are sufficient for basic skill development and performance.

- Aluminum arrows are more expensive than fiberglass or wooden arrows and, though rugged, they can be bent; but they are the best choice for tournament shooting.

In addition to material, length is one of the most important aspects to consider in selecting arrows. Bow and arrow lengths should be correlated as well as possible. That is, since most manufacturers are making 62-inch (157.5-centimeter) and 66-inch (167.6-centimeter) bows for school and beginner use, 24- to 26-inch (61- to 66-centimeter) arrows should be used with the shorter bow and those which are longer than 26 inches (66 cm.) should be used with the longer bow. Shorter arrows can be used with longer bows, but they lack the power of the correlated-length arrows because the efficiency of the bow decreases with a shorter draw. In a similar way, longer arrows can be used with shorter bows — within limits. For this reason, it is advisable to label each bow with the maximum arrow length for which it was made.

Other tips include the following:

(1) Arrows with a diameter of 5/16" (about .8 cm.) are best for group shooting, since those which are narrower tend to break and cracked or broken arrows are difficult to salvage. If the arrow breaks near the point (or pile), it can sometimes be cut back and tipped to form a shorter arrow. However, if it splits through the nock, the arrow should be destroyed because the pressure against the nock on release can cause the arrow to fracture and severely injure the archer.

(2) Arrows with machined steel or brass piles are preferred for group and tournament shooting because cast piles are often made of softer metal (which blunts more easily) or have smaller holes for receiving shafts, which makes the union between them less stable. Since changes in temperature and

humidity can loosen the pile, it is wise to pin or "knurl" the tips on arrows which will be in frequent use. Piles which have not been knurled can be recemented with ferrule cement or gum shellac if they become loose.

(3) It is advisable to buy arrows in colors that can readily be seen against the background in which they will be used, and divide them into sets by applying a band of colored tape to the shaft of each arrow to form an identifying "crest." If the arrow is then labeled with a number just below the crest on the cock feather side, replacements can be made by applying the crest and number of the lost or broken arrow to a new one, and adding it to the set.

(4) If the nocks on some of the arrows selected for use are separate attachments made of molded plastic (and these are highly recommended), the purchase order should include a supply of extra nocks. Then, when the nock on an arrow is damaged, it can be removed and a new one attached with fletching cement.

(5) In order to retard warping and/or damage to the feathers, arrows should be quivered during shooting times and stored in an arrow rack or a box with a series of holes in the top (or a "shelf" near the top) which will accommodate them in sets.

Student archers should be as carefully equipped with proper length arrows as they are with proper weight bows, in order to prevent overdrawing. Arrows correlated with bows on the lighter end of the ranges suggested on p. 5 are a good beginning. Other methods include measuring the distance from the chin to the knuckle of the first finger of the bow arm (elbow slightly bent as in shooting) when the head is turned toward the bow hand, or between the chest and the fingertips when the arms extend forward (neither reaching nor stretching) with a yardstick or meterstick between the palms of the hands. Perhaps the simplest way is to lift one arm until it is perpendicular to the shoulder and hold an arrow parallel to it, nock against the chest. If the length is right, the arrow will extend an inch or two (approximately 2 1/2 to 5 cm.) beyond the fingertips. Methods of this type provide approximate measures only, however; more accurate lengths can be determined when the students are comfortable with the tackle and have begun to develop shooting positions that work best for them. The recommendations on p. 12 suggest that several dozen arrows be purchased in each of a variety of lengths. If the budget won't permit so large a supply, it is safer to issue arrows that are longer *(not shorter)* than the student's requirements, in order to prevent injuries that could result from overdrawing.

Arm Guards and Finger Protectors

Used by archers at all levels of proficiency, arm guards and finger protectors are essential for beginners.

Arm guards protect the inner side of the bow arm and wrist from contact with the bowstring when the arrow is released. They should be heavy enough

to prevent stings and bruises, but sufficiently pliable to fit comfortably and well. There are a number of types. For general class use, those made by 7- by 3- to 4-inch (17.8- by 7.6- to 10.2-centimeter) pieces of strong but flexible leather or leather-like plastic which attach to the arm with straps and buckles are highly recommended. Guards equipped with hooks and laces are also available, but they are difficult for the archer to manage alone; and those with elastic bands, though less expensive, will neither stay in place as well nor last as long as laced or buckled types. A variation called a training guard which extends from the wrist to well above the elbow, is helpful for students who have difficulty with bow-arm elbow position.

There are two basic types of finger protectors:

(1) Finger tabs are roughly 4- by 5-inch (10.2- by 12.7-centimeter) pieces of heavy, smooth, and pliable leather or leather-like plastic with holes for the string fingers and a notch for the arrow. Depending upon the weight of the material, they may be one, two, or three layers thick and can easily be made.

(2) Shooting gloves resemble standard leather gloves with the fourth or "little" finger and thumb sheaths cut away. Another type consists of three straps folded over on one end to form sheaths or "stalls" for the string fingers and connected to a wrist band on the other. Appropriately enough, it is sometimes called a skeleton glove.

Whatever the choice, the most important features to be considered in buying finger protectors are that they be flexible enough to allow the archer to feel and control the bowstring, solid enough to protect the string fingers, and smooth enough to minimize friction as the string rolls off the fingers on release.

Bow Straps and Finger Slings

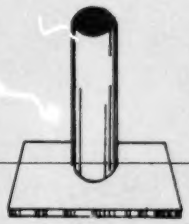
These are aids which bind the bow to the bow hand at the wrist or thumb and fingers. Because they improve the archer's control of the bow by stabilizing the wrist and hand in holding it, they are recommended for beginners who have difficulty in handling the bow and for students with weak or loose grips, particularly spastic cerebral-palsied students who have a tendency to drop the bow the moment they release the string. Like finger tabs, bow straps and finger slings are easily made from pieces of leather or leather-like plastic.

Quivers

Quivers are containers for individual sets of arrows. There are three basic types — one for outdoor programs, another for indoor or outdoor programs, and a third which is often part of the archer's personal equipment.

(1) A ground quiver consists of a metal stake topped by a hoop (about 2 1/2 to 3 inches or 6 to 8 cm. in diameter) which parallels the ground and holds the arrows nock end up. If the hoop is large enough, it can also be used to support the bow. Quivers of this type are available commercially and can be improvised from heavy-gauge wire coat hangers. They are particularly useful for wheelchair archers.

(2) A floor quiver has a square base with a cylinder attached to the center. Although dimensions vary, 7 inches (about 18 cm.) on a side for the base and 12 inches (30.5 cm.) in height and 2 1/2 to 3 inches (6 to 8 cm.) in diameter for the tube or container are average figures. If the ground is level and/or the base heavy enough to be stable, the floor quiver can also be used for outdoor programs. Like the ground quiver, it can be made from readily available materials or purchased from equipment suppliers.



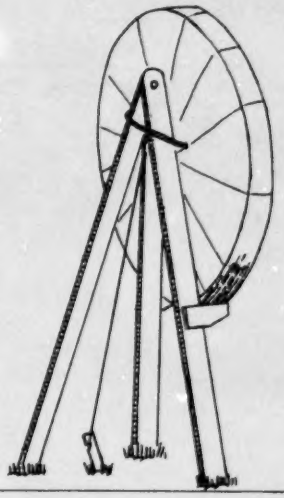
(3) As the name implies, a body quiver is worn by the archer — either slung across the shoulders or suspended from a belt at the waist. Since it moves with the wearer, its primary uses are for bowhunting, for novelty events and performances, and for archers who prefer to buy and use their own equipment. Made of leather or leather-like material, body quivers are available in a range of styles and prices, but are less practical than ground or floor quivers for general class use.

Bow Racks

Racks designed to hold the bows while the archers are waiting to shoot can easily be made from lengths of wood, tubular aluminum, or lead pipe; strips of nylon webbing (the type used for lawn chairs); and an appropriate number of nuts, bolts, and washers. If lead pipe is used, elbows will be needed for the corners, and the arms of the rack should be covered with garden hose to prevent any damage to the bows which will lie across them with the strings up and the stabilizers down. Like their counterparts for luggage, bow racks can be folded and stored when not in use.

Targets

The familiar tripod with a round straw matt and colorfully ringed target face is the **regulation target** for archery. The stand is available from almost any sports equipment dealer, but can easily be made by bolting three 6-foot by 4-inch by 1-inch (2-meter by 10.2-centimeter by 2.5-centimeter) pieces of soft wood at one end to form a tripod, and adding a pair of matt supports by nailing a 10-inch (25-centimeter) piece of the same type of wood to each of the two front "legs," about 30 inches (76 cm.) above the ground. When used outdoors, the stand and its target should be bound together and staked to the ground (see diagram at right) in order to keep them stable in the wind. When used indoors, regulation targets should be placed on mats made of rubber or other nonskid material, the legs hobbled with rope, or the feet tipped in ways that will keep them from slipping. When not in use, the stand can be folded and stored with relative ease; but since it must absorb the shock of arrows, it should also be checked each time and, if necessary, tightened or repaired.



Round **target matts** made of compressed rye grass covered with burlap are the ones most often used for outdoor programs in archery; but **straw butts** made of three burlap-covered bales of straw placed one atop the other on a movable support are heavier, considerably less expensive, and because the bales can be turned and interchanged in the stack, much longer lasting than the regulation straw matts. They are particularly good for indoor programs and beginners. The movable support consists of a solid base and back made of wooden boards and two-by-four's mounted on a set of rubber-tired wheels or castors.

Regulation **target faces** are round or square sheets of oilcloth or reinforced paper with a scoring face, a "petticoat," and a drawstring for fitting the sheet to the matt. Those made of "toughenized" or fiber-reinforced paper are highly recommended. The **scoring face** consists of a yellow/gold center and four concentric rings — red, blue, black, and white. In proper placement, the center should be about 51 inches (130 ± 5 cm.) above the ground. The values assigned to the scoring areas are these:

	Inside Circle	*Outside Circle*
Gold	10	9
Red	8	7
Blue	6	5
Black	4	3
White	2	1

All dividing lines are in the higher scoring area, so an arrow which touches a line counts for the higher value in each case. (Incidentally, using

materials with a different texture for the center and each ring can be a valuable aid for students who are visually handicapped, and a transistor radio or some type of "homing" device attached to the back of the matt at the center will help these students to "find the gold" when they shoot.)

Since the "bull's eye" and the red circle are the first to show wear, it is advisable to have a number of replacements for these areas on hand. They can be purchased in inexpensive 25-patch lots and could double the life of the target.

RECOMMENDED TACKLE for COEDUCATIONAL* CLASSES of 24 STUDENTS	
Quantity	*Item*
28	BOWS 23 Right-hand bows 10 20# (9 kg.) 8 25# (11 kg.) 5 30# (14 kg.) 5 Left-hand bows 2 20# (9 kg.) 2 25# (11 kg.) 1 30# (14 kg.)
25 doz.	ARROWS 2 doz. 23" (58 cm.) 3 doz. 24" (61 cm.) 4 doz. 25" (64 cm.) 5 doz. 26" (66 cm.) 4 doz. 27" (69 cm.) 3 doz. 28" (71 cm.) 2 doz. 29" (74 cm.) 2 doz. 30" (76 cm.)
6	RYE STRAW TARGET MATTS 48" (122 cm.)
15	TOUGHENIZED TARGET FACES 48" (122 cm.)
28	BELT QUIVERS
36	FINGER TABS 28 Right-hand finger tabs 12 small 12 medium 4 large 8 Left-hand finger tabs 3 small 3 medium 2 large
28	ARM GUARDS 24 Regular arm guards 4 Training guards
28	FINGER SLINGS
15	SPARE BOW STRINGS
12	ARROW RESTS
1	NYLON CORD BOW BRACER
1	BOW SQUARE
5 doz.	EXTRA NOCKS
	MISCELLANEOUS ITEMS (Target stands and the necessary spikes for attaching target faces, if these are not available from industrial arts or maintenance personnel, and whatever adaptive equipment seems to be appropriate for handicapped students.)

**If the program participants are primarily girls or primarily boys, adjust the number of lighter bows/shorter arrows and heavier bows/longer arrows accordingly. If elementary school children are to be included, order an appropriate number of 10- to 15-pound (4 1/2-to 7-kilogram) bows and shorter arrows.*

TEACHING AND LEARNING

THE PRELIMINARIES

A well-planned, well-executed introduction to archery can practically eliminate the dangers inherent in the use of a lethal weapon like the bow. For this reason, the sport can be included in elementary and middle school physical education programs as well as in those for junior/senior high school students and adults. However, the classes should be smaller and a greater emphasis placed on safety. In addition, the goals and equipment for younger pupils should be appropriate to their particular characteristics, for their underdeveloped finger dexterity and kinesthetic awareness will hamper progress, their shorter attention span will require varied activity and more personal care, and their not-yet-mature limbs and frame will make shorter bows and arrows and smaller arm guards and finger protectors a necessity. The following suggestions are designed for high school programs in archery, but can be used at any level if modifications and adaptations are made for the specific needs, interests, capabilities, and limitations of the students who will participate.

A certain amount of planning is necessary for any venture in curriculum, and this is especially true for archery. Since the first session is primarily orientation, the class can be as large as the space and its hearing/seeing capabilities will allow. In the next few classes, however, the students will be using archery equipment (many for the first time) and will therefore require close supervision and individual coaching to insure both safety and success. These classes should therefore have a pupil/teacher ratio of 15 to one. Later classes can be larger if the students grasp the fundamentals and seem to be responsible in handling the tackle. Teaching assistants and/or leader's club members who are skilled in archery can be helpful in dealing with the large classes that so often characterize physical education. An alternative is to divide the class into groups of 15 or so and rotate archery instruction from group to group while all but one are engaged in some other form of activity (badminton, tennis, track and field, softball, etc.). If the initial stages are held indoors, part of the class can learn from films or tapes while the other is shooting, and then reverse the procedure.

PRE-CLASS PREPARATION

Two or three hours of preparation before the initial class will pay huge dividends in both time and enthusiasm. Here is a checklist of things to do before the class begins:

- Set the targets up and stake them to the ground with a rope (see diagram on p. 11). One target blown over can cost at least four sets of arrows.

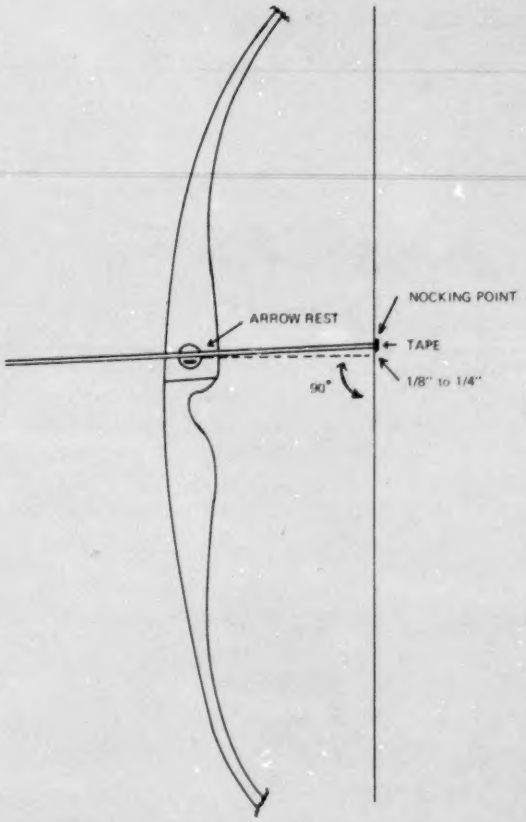
- Be sure the shooting lines are marked (see diagram on p. 2). A center line should run directly back from each target through the shooting lines. Non-caustic lime, paint, or tape can be used, but making them from the plastic lids of coffee cans is also quick and easy. Place the lids at the center point in front of each target and fasten them to the ground with long nails driven through the centers. The lids should be secure enough — and low enough — to permit maintenance personnel to mow over them without difficulty.

- Paint or stencil a bow number on the upper limb of each bow. This will enable the students to select their bows quickly from those on the rack, and helps the teacher to make appropriate reassignments as individual needs and abilities change.

- Make certain all bow strings are in good condition.

- Check the brace height (the distance between the bow handle and the string) and brace all bows. Moulded glass or laminated bows may be left braced when they are regularly in use. This will certainly be helpful during the first few sessions.

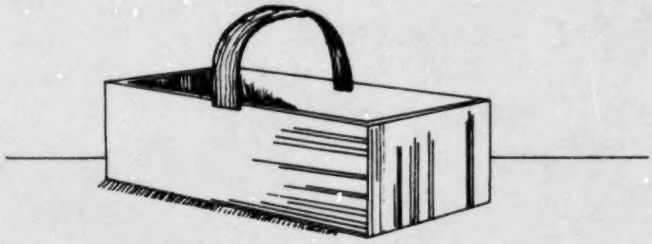
- Mark a nocking point or "nock locator" on each bow string. Use a bow square to determine the perpendicular from the string to the arrow rest. When the arrow is nocked on the string, the bottom of the nock should be at least 1/8 to 1/4 of an inch (.32 to .64 cm.) *above* this perpendicular for the arrow to fly well. Mark the spot with masking tape or mystic tape (as in the diagram at right).



- Be sure that each bow has a commercial sight mounted on it, or put a strip of mystic tape on the face of the bow along the sight window and insert a large-headed pin about 2 1/2 inches (6.4 cm.) above the arrow rest so that it extends into the sight window.

- Arrange the arrows in sets of six (if this hasn't already been done) according to their length and crest. Sets can also be made from arrows with differing crests if the lengths are equal and the shafts are labeled with the same identifying number.

- Get the arm guards and finger protectors ready for use. These can be stored and carried in a fruit basket with a handle like the one shown below.

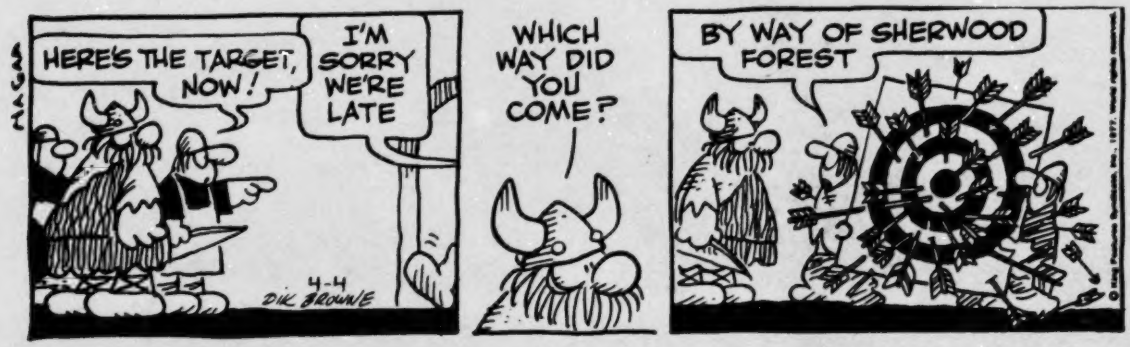


- Prepare a teaching kit. Another fruit basket, a tool box, a fishing tackle box, or something similar which contains the following materials is a very useful item to have on hand:

* A bow square	A rope bow stringer
* A pair of pliers	Elastoplast (1-inch)
* Masking tape	Rubber bands
* A jackknife	Band-aids
* Glue	A cold pack
* Matches	Extra finger protectors
** Mystic tape	Extra bow strings
** Large-headed pins	Extra arm guards
** Pencils	Extra arrow rests
A whistle	* Extra nocks
A pair of scissors	

**Used to repair or replace nocks or nocking points*
***Used to improvise a sight*
All other items are first aid or general purpose materials.

- Prepare a measuring arrow. Using a brush pen, mark the longest arrow in stock with 1-inch (2.54-centimeter) gradations from the tip back to 23 inches (58.4 cm.) from the nock, as shown in the diagram on p. 6.



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A SUGGESTED PLAN OF INSTRUCTION

SESSION 1: Orientation

Show the equipment to be used and name the various parts so that students will become familiar with the terminology. Then demonstrate and discuss the nine steps in the shooting sequence:

(1) Stand

(2) Nock

(3) Extend

(4) Draw

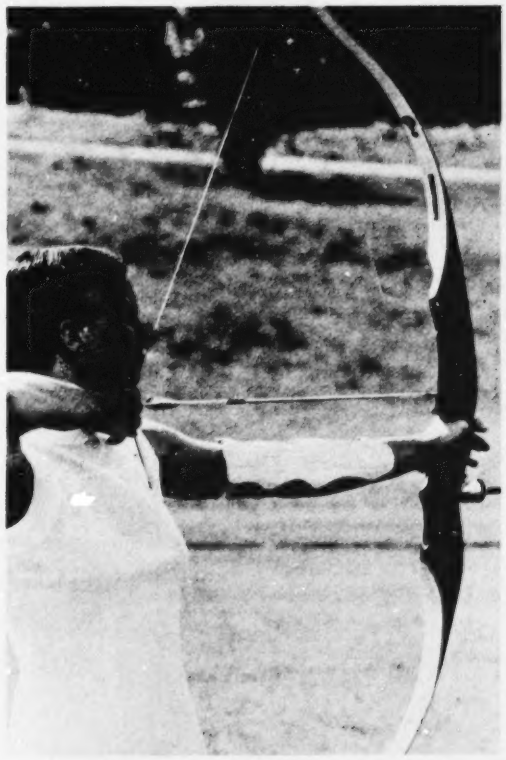
(5) Anchor

(6) Tighten

(7) Aim

(8) Release

(9) Afterhold



- Give particular attention to the proper position of the bow arm at the shoulder and elbow; the bow hand; the string hand, finger, and wrist; the elbow height of the drawing arm; and the anchor position.
- Emphasize aiming with one eye closed. The aiming eye is on the same side of the body as the string hand.
- Always refer to the hands as the *bow hand* and the *string hand.* This simplifies teaching right- and left-handed archers, and saves repetition of instructions.

Measure each student for proper arrow length. Do this by helping him or her to draw the lightest bow correctly, using the measuring arrow described earlier. Determine the length by seeing which mark on the arrow is at the back edge of the bow. (For alternative ways of measuring, see p. 8.)

Correct arrow length is important to accuracy in shooting. Be sure that all the students know their own arrow lengths so that they will get the correct arrows for the next class.

SESSIONS 2 and 3: Shooting

*PART ONE**

Teach safety in this and every session, as the students will be using a lethal weapon. The following whistle signals should be presented during the part of this session just before the students begin to use tackle:

One whistle	=	Shoot
Two whistles	=	Retrieve arrows
A series of short blasts	=	*EMERGENCY! Let down immediately!*

Have the bows strung before class and the sight pins set about 3 inches (7.6 cm.) above the arrow rest. (This approximates the space between the chin and the eye, and should put the arrows on the target at the distance to be used.) Set the targets at 15 or 20 meters, then demonstrate the following steps and have each student go through them without tackle:

- Take the proper stance, straddling the shooting line.
- Extend the bow arm to the target, palm down, with the thumb and first finger spread apart. Rotate the wrist until the thumb is up — *without moving the elbow.* This will produce the correct elbow position (if the elbow were flexed, the hand would move toward the chest). Check each student for correct position.
- Form a hook with the second, third, and fourth fingers of the string hand, allowing the thumb to relax and contact the little fingernail. The back of the hand and wrist should make a straight line to the elbow. Turn the head to the target, and reach out and hook the three fingers on an imaginary string.
- Extend the bow hand to the target *thumb up.* Reach with the string hand and hook onto the thumb, rather than the imaginary string, to get the feel of a real hook.
- Draw the imaginary string back. Keep the hand close to the bow arm until the draw hand touches under the chin. Make the action come from the upper arm and back muscles.
- Repeat, using the thumb of the bow hand as a string so that there will be some resistance.
- Stress anchor position. The second joint of the string hand should be touching under the center of the chin. The elbow should be well back and in line with the string hand.

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* *REMINDER: For initial classes in shooting, class groups should be no larger than 15 students per teacher.*

- When correctly anchored, TIGHTEN the back muscles. (This is when the archer aims.)

- To release, consciously bring the shoulder blades toward each other. This forces the string hand to come back along the side of the neck.

- Again using the thumb of the bow hand as a string — hook, anchor, and RELEASE.

- Hold for three counts as an afterhold.

- Repeat the whole procedure quickly, emphasizing and naming the nine basic steps outlined on p. 17.

Then have the students pick up the bow with the bow hand and:

- EXTEND it to the target in the correct position.

- Go through the mimetics of drawing, anchoring, and releasing with the string hand — *but without actually drawing the string.*

- With the bow in hand, hook the fingers on the string and extend the whole unit to the target, with the bow in a vertical position.

- Draw the string a short distance to get the feel of it, and then let up. (Each student should be checked for correct elbow position of the bow arm.)

- Again with bow only, extend to the target and, closing one eye, place the sight pin in the center of the gold. This is the aim.

At this point, stop and explain how to nock an arrow properly. Lay the arrow across the bow at the arrow rest, and nock it just below the nocking point so that the cock feather is up. Then have the students take both bow and arrow and:

- Practice nocking and check the position of the hook on the string.

- Practice the beginning of the draw, emphasizing the action of the back. The fingers and the hands should be relaxed (not squeezing), or the arrow will fall off the rest.

- Draw, anchor, and th[illegible] let down.

- Draw, anchor, AIM, and then let down. Repeat several times.

When the group is ready to shoot, each student should release the first arrow in his or her set under the direct supervision of the teacher. (This is most important, for in addition to its value as a general precaution, it will help to prevent bruised elbows!) Some students will probably need help in releasing the string. Those who do well should be encouraged to shoot the rest of the arrows in their sets.

Retrieve the arrows, demonstrating how to draw them from the ground without damaging them. Then have the students gather around the target, and show them how to draw the arrows safely from it. (Place one hand against the target and with the other, grasp the arrow as close to the target face as possible. Push against the target with the one hand, and twist and pull the arrow with the other. This will prevent the target from moving.) Be sure that all the archers are away from the target while the arrows are being pulled from it, as an arrow being drawn will come out with difficulty and the recoil could cause an injury. While still near the target, explain the point values of the scoring face.

PART TWO

Again, have the bows strung and the sights set before the class begins. Set the targets at 18 meters.

Quickly review the mimetics without tackle, emphasizing the bow hand position. Then have the students draw, anchor, aim, and let down on command. While they are doing this, move up and down the line watching for those who need help. Be particularly conscious of hunched left shoulder and elbow positions, as these are the two factors that cause injured elbows and destroy enthusiasm for archery. Few bruises hurt more than one caused by a bow string.

Each student should shoot an end (6 arrows), using the sight. Have the archers step back at least 2 meters from the shooting line when they have released their six arrows. Coach those who need help.

> REMINDER: Arrows should be retrieved at a double-whistle signal. Make certain that all archers understand this.

After the second end, explain how to adjust the sight for accuracy. The sight moves in the direction the arrows are going. If the arrows are high, move the sight up; if they go to the right, move the sight to the right; ....

Continue shooting and coaching as time permits. Stress safety at all times so the archers will be aware that they are using a weapon. The following things are especially important:

- Be aware at all times of the movement of people around the shooting area.
- Re-emphasize the whistle signals and their importance.
- Be sure that no one draws a bow unless s/he is standing (or sitting, in the case of wheelchair archers) in the shooting position.
- Stress correct arrow retrieval (many accidents occur here).

SESSION 4: Bow Bracing and Unbracing, Setting Sights, and Shooting

Unless there are special problems or circumstances to prevent it, the small groups of beginning archers can now be combined for regular-class-size/large-group instruction and practice.

SESSION 5: Scoring and Marking Sights

- Review and recheck any of the preceding steps that seem to need emphasis.
- Using scorecards at each target, teach proper scoring.
- Mark the sight on each bow by drawing a line at the pin and marking it *18* for 18 meters.

SESSION 6: Using Marked Sights at 18 Meters

- Set the sights at 18 meters. Try them. Are the settings accurate?
- Move the targets to 25 meters and determine where the sights should be set. The setting will probably be about 3/4 of an inch (1.9 cm.) closer to the arrow rest. Try it for accuracy.
- If the setting is correct (or nearly correct), mark the sight for 25 meters.
- Demonstrate and discuss string alignment.

After these six sessions, select one or two things (bow hand position and bow hand release, string hand release, etc.) that seem to need re-emphasis, and work on these for a full class period. Close observation of each class will indicate which items need further development.

STRATEGIES FOR GROUP TEACHING

Many successful teachers use a buddy system for archery. Sometimes called *reciprocal teaching*, the approach can be very helpful to students who can recognize their own faults as they see them in others. However, in order to make the system work, it is essential that the buddy be given instructions as well as the shooter.

Another useful technique is to choose a coaching assistant from the students in each class. This works best if the assistant is also given time to shoot during the class period.

To keep enthusiasm high, it is important to let the students progress without being given too much information or direction at a time. Help them to feel successful. The first "gold" is as important to a beginner as the first "perfect end" is to an advanced archer. Make an event of it!

Variety is another way of keeping interest high. Some of the things that add spice are listed below — use them and/or others of your own creation to promote both interest and progress.

- Run a short tournament, shooting and scoring at two different distances — the longer always first. Directions for holding a tournament are clearly described in the *Archer's Handbook*, which also includes all tournament rules.
- Do clout shooting (see definition on p. 34). Clout shooting is fun and really helps form.
- Reverse the scoring for an end.
- Have the students shoot from a kneeling position.
- Play "archery poker," having the students shoot five arrows for the best "poker hand" on the target.

PROBLEM DIAGNOSIS AND PRESCRIPTION

During every class session, the teacher should be aware of individual needs and be in a position to give individual help without jeopardizing the safety of the other class members as they continue their practice. The following suggestions may be useful in diagnosing and prescribing for specific types of problems.

- If the arrow keeps falling off the rest while the student is drawing,
  (a) The back of the drawing hand may not be flat.
  (b) The fingers may be squeezing.
  (c) The fingers may be pinching the nock.
- If the student has trouble reaching a full draw,
  (a) A lighter bow may be needed.
  (b) Sometimes a kisser button (see p. 35 for definition) will help.
- If the string hits the student's elbow,
  (a) Check for proper bow hand position and rotated elbow.
  (b) See whether the shoulder is rolled *in* or *up* on the bow arm side.
  (c) Have the student use a training guard, or two regular arm guards overlapped.
- If the string hits the student's chest or breast,
  (a) Suggest moving the foot that is closest to the target slightly back, so that the stance will be a bit more open.
  (b) Show the student where the string should contact the body, and get it there by keeping the string close to the bow arm on the draw.
- If the student misses the target consistently on one side,
  (a) Be sure that the correct eye is being closed.

- If the arrows fly LOW,
  - (a) The arrow may not be at full draw before release.
  - (b) The fingers may be relaxing instead of sliding back off the string.
  - (c) The bow arm may be dropping before there has been sufficient followthrough.
  - (d) The archer may be looking up too soon to see where the arrow hit. (Emphasize *watching the gold* until the arrow hits the target.)

- If the arrows fly HIGH,
  - (a) The archer may be looking up from the gold and raising the bow arm at the same time.
  - (b) The fingers may be jerking, rather than sliding off the string.
  - (c) The right elbow may be moving *down* instead of *back*.
  - (d) The bow arm may be jumping.
  - (e) The sight may not be set correctly.

- If the arrows fly LEFT,
  - (a) The sight may not be set correctly.
  - (b) The left shoulder may be hunched.
  - (c) The bow arm may be moving to the left.
  - (d) The bow may be tilted to the left.
  - (e) The string may not be aligned with the left edge of the bow on the draw.
  - (f) The string may not be aligned with the middle of the nose.
  - (g) The string hand may not be firmly *under* the jaw bone. (Watch for an anchor on the edge of the jaw.)
  - (h) There may be too much hand behind the bow. (The pressure should be just to the thumb side of the long curved line around the thumb.)

- If the arrows fly RIGHT,
  - (a) The archer may be using the wrist and fingers rather than the shoulders on the release.
  - (b) The bow arm may be moving to the right.
  - (c) The archer may be collapsing, instead of following through on the release.
  - (d) The left elbow may be rotating inward.
  - (e) The bow may be tilted to the right.
  - (f) The third and little finger may be rotating upward, instead of pulling back on the release.

QUICK ANALOGY TEACHING CUES

MIMETICS

- Use the thumb of the bow hand as a string in practicing the draw and anchor.
- Hook the first three fingers of the drawing hand to the first three fingers of the bow hand, come to an anchor position, and pull with the back until the fingers slip apart. The archer should feel the drawing fingers come back into the neck.
- Shake thumbs with your partner to get the feeling of pushing against the bow.

BOW HAND POSITIONING

- The thumb and first finger should form a Y with the wrist and forearm.
- The fingers, if flexed, should point to the ground.
- The pressure of the bow should be distributed between the V formed by the first finger and the thumb, and the base of the thumb in the center of the hand.
- The heel of the hand (below the little finger) should *not* be putting pressure against the bow.
- The fingers should be relaxed.

BOW ARM POSITIONING

- The arm should be straight and locked with the elbow rotated down and back.
- If the elbow is in correct position, the hand will come to the chest when the elbow is bent. If the position is *not* correct, the hand will hit the head.
- The point of the elbow should face the archer behind you.
- Shoulders level. The shoulders should be in line — avoid hunching or raising the shoulder of the bow arm.

HOOK ON THE STRING

- The first three fingers should form a hook, with the arrow between the first and the second.
- Relax the thumb and little finger — let them hang or curl as they will.
- Distribute the pressure evenly among the three fingers.
- Hook almost to the first joint.
- There should be a straight line from the hook to the elbow.

Once the bow hand and the hook are in position, raise the whole unit and place the sight in the gold!

STANCE

- Hip socket to the target — straddle the line.
- Weight equally distributed — center of gravity between the feet.
- Feet a comfortable distance apart — otherwise wind may blow the body off balance.
- Correct body alignment.

NOCKING

- Place the arrow below the nocking point, the cock feather away from the bow.
- Let the bow hold the arrow — keep your thumb and fingers off.

DRAW

- Push and pull equally. Push against the bow as you pull the string back until it bumps the center of the chin and nose.
- The back muscles should do the work.
- No squeezing with the fingers — this causes the arrow to fall off the rest.
- Don't waste time on a slow draw!

ANCHOR

- Lift your chin as you draw to make room for the forefinger underneath.
- Find the center of your chin and nose with the string.
- Feel the forefinger under your jaw.
- Right elbow up!
- The point of the elbow should be directly behind the tip of the arrow. (This is when you feel the muscles between the shoulders come into play.)

AIM AND HOLD (*This is the crucial step.*)

- Close your left eye (right eye for left-handed students).
- Sight in the gold.
- Aim carefully. A bird's eye isn't good enough — aim at the pupil of the eye.
- Hold until still.
- Take your time.
- "Squeeze a quarter." Imagine a quarter held between the forearm and the upper arm at the elbow. Be sure it doesn't drop out while you're aiming.

- See the string as a blur at the edge of the sight window.
- *Concentrate!* Don't hear or see anything except the gold during this step.
- Tip the torso. In raising your sight, bend at the waist rather than leaning back.

RELEASE

- Relax the hook.
- "Feed the gold" — action of the bow hand toward the gold.
- Feel your fingers in your neck.
- Is your sight in the gold? (There is a tendency to drop the bow arm on release and get low arrows.) Think of a glass of water on a ledge.
- Is your right elbow up? (There is a tendency to pull this elbow down on the release if the back pressure is too low, and then the arrows fly high.)
- Watch the gold, not the arrow — or you will move the bow out of position and check its action of moving toward the gold on release.
- Let the bow do what it wants to do — you don't need to hang on!
- Roll your fingers off the string.
- "Squeeze the accordion." Keep the back tension, shoulder blades moving toward each other.
- Hit my hand with your elbow on the release. (The teacher's hand should be about 2 in./5 cm. behind the student's elbow.)
- Let the bow shoot the arrow.
- Spread the chest.
- Wave at the target.

FOLLOWTHROUGH

- Hold your position until you *hear* the arrow hit the target.
- No fair peeking — if your arrow goes into the gold, you'll see it!
- Check your shot:
  - ✓Were you aimed?
  - ✓Correct string alignment?
  - ✓Back tension caused the release?
  - ✓Bow arm up?
  - ✓Did you feel the fingers in the neck?

  Develop a list of items appropriate to your own needs and check it after every shot.
- *After* you've checked, let down.
- If the shot was a bad one, *forget it* — and shoot the next one into the gold.

ASSESSMENT AND EVALUATION

The real success of any teaching program in physical education is best shown when the students seek opportunities to continue the activity outside of class. Is attendance good when the activity is offered in intramural, extramural, or varsity programs? Do the students seek to continue the activity in the community? Archery is like every other sport in this respect. A good teaching program will fill the intramural program with participants, a local archery club will get new members, and a local tournament will swell the ranks of the Juniors and Intermediates.

To assess the learning of individual students, it is well to give a short written test. This also helps the teacher to find the weaknesses in his or her teaching, and to be sure that terminology is correctly understood (many students translate *gold* as *goal* — which it really is!). Keeping a record of scores for several days is another good way to judge success. The higher the scores over a period of time, the better the shooting form — as one depends upon the other. Various issues of the NAGWS *Archery-Golf Guide* contain suggested ways for students to evaluate each other. But the best method, perhaps, is to set specific, progressively more challenging objectives to be met. These should be appropriate to the students' level of achievement and designed to improve performance through a series of small, but significant successes. For example, they might include such items as the following:

- All the arrows in an end (6) in the target — no misses!
- All the arrows in *each end* in the target.
- Half the arrows in an end (3) in the *gold*.
- Half the arrows in *each end* in the gold.
- Four consecutive scores over 40 at 18 meters.

As each objective is achieved, a more difficult one can be set. Teachers and/or students can keep a record of individual development and post a progress chart for each class or for all the classes, conduct a contest, or schedule matches, tutorial or practice sessions, games, competitive events, etc.

CROSSDISCIPLINARY ACTIVITIES

Because archery has so ancient a heritage, it lends itself to a variety of crossdisciplinary activities which can extend the students' achievements in several subject areas while synthesizing or bringing closure to their otherwise fragmented learning experiences. Archery abounds in literature and art, is symbolized in zodiac and sky, has influenced history and modern law, and depends upon fundamental principles of science and math. Students who solve projectile problems in physics class *and* on the archery range should hit more golds as they build their understanding of trajectories, the forces that affect them, how, and why. The reverse is also true. Thus physical education teachers and those in other subject areas might find it mutually beneficial to develop a battery of crossdisciplinary reinforcement activities like those on the following pages.

In conjunction with:	The students might:
ART EDUCATION	• Create a montage or collage of pictures, photographs, and/or items related to archery.
	• Develop posters, book covers, and/or advertising displays for archery or bowhunting tackle, clothing, safety precautions, coming events,...
	• Design an emblem and/or a uniform for the local archery team or club.
	• Develop a variety of emblems or logos and make a composite design, or reproduce a single logo in a variety of colors and/or contrasts a la Yaacov Gipstein (Agam), or Victor de Vasarely.
	• Identify and collect pictures of works of art which depict archers (e.g., Andreotti's *War Memorial; Archer* - African, Benin people; Bourdelle's *Heracles as Archer* and *Selene with a Bow;* Brousseau's *Archer Stringing Bow;* Casella's *The Primitive Marksman;* Diederich's *Diana and Hound;* Hildebrand's *Archery Lesson;* Huntington's *Diana of the Chase; Indian Archer* - American Folk Art, weathervane; Mestrovic's *Archers of Demorgoi;* straw figures with bow and arrow - Moi people; Tennant's *Archer - Tejas Warrior).* Relate form, materials, and specific characteristics to the artist's intent.
	• Sketch, paint, photograph, or sculpt members of the archery class, team, or club in static poses and action demonstrations of correct form for any or all of the nine steps in the shooting sequence.
	• Film a tournament at close range or with a telescopic lens and then develop a series of stills from selected frames. What do the photographs reveal about the balance, form, directionality, etc., of the archer's body at specific times during the activity?
	• Use the arrow's trajectory as the basis for a line drawing, a print, an example of progressive rhythm or op art, a light show, etc.
	• Interpret some aspect of archery, including attitude and impression as well as behavior, in an objective or nonobjective work of art.
	• Compare the use of such elements as *time, space, force, motion, directionality, light, line, rhythm, contrast, emphasis, texture, balance, etc.,* in archery, music, and/or the visual and language arts.
CAREER EDUCATION	• Analyze themselves in terms of current behavior, activity, habits, characteristics, etc., and then look at the qualifications and working conditions in careers related to archery. For example, do the students seek company or prefer to be alone? Are they asked for help or an opinion, and do they usually give it successfully when asked? For what kinds of activity do they volunteer, if any? What do they really do, as opposed to what they think they'd like to do (e.g., do they make things? work with numbers, or ideas? hunt? take pictures? sketch? scribble? organize their peers for a purpose, and then achieve it? delegate responsibility, or do the job themselves?) Then they might explore the career aspects in such fields as teaching; officiating; sports reporting; organizing hunting parties; designing, making, selling, advertising, or managing any of these processes for tackle and/or sportswear; photojournalism; managing teams or individual archers, seeking sponsors, writing contracts, etc.
	• Explore the Junior Achievement, Inc. program and, if interested, form a company with regard to some aspect of archery.
CONSUMER EDUCATION	• Conduct a consumer fair, inviting representatives from sports equipment firms to demonstrate their wares. Which items seem to be the "best buys" for the local situation? Why? To what extent does the manner in which the product is packaged or presented tend to influence consumer choice?

In conjunction with:	The students might:
CONSUMER EDUCATION	• Do a cost/benefit analysis of various types of tackle (e.g., take-down vs. standard bows, cedar vs. fiberglass arrows) in terms of potential user needs and interests. Which items seem to offer the most for the money, and why? • Develop a budget for an archery team or club, including expenditures for facilities, equipment, materials, services, travel, etc., with possible alternatives and a justification for these expenditures in terms of their anticipated use as it relates to the school's needs, values, resources, and population-to-be-served. • Hold a flea market during which they demonstrate and display their own equipment, describe the advantages and disadvantages of various items in terms of their own needs and abilities, and have an opportunity to buy, sell, or swap. • Do market research, identifying the factors which influence the production of items related to archery and the choices made by consumers. What are people buying, and why? How profitable is the venture, and why? Project trends in these areas. How good are the prospects in this field for investments, or careers? What could be done to improve these prospects?
ENGLISH LANGUAGE ARTS EDUCATION	• Do a sportscast on closed circuit T.V. or write a news article for the school or local newspaper which features some aspect of the archery program. • Play HANGMAN or develop a crossword puzzle with terms from archery. • Explain the derivation of such surnames as *Archer, Arrowsmith, Bowman, Bowyer, Broadhead, Fletcher, Stringer, ...* (check the telephone book for others). • Explain the meaning and the derivation of the following phrases, using them in sentences whenever appropriate: *Brace yourself* — *To miss or overshoot the mark* *The butt of his jokes* — *To pick a quarrel* *A fool's bolt is soon shot* — *Point blank* *To get the shaft* — *Rule of thumb* *High strung* — *Straight as an arrow* • Explain each of the following quotations both in and of itself and as it relates to the circumstances of the play from which it was taken: *An arrow shot* *From a well-experienc'd archer hits the mark* *His eye doth level at.* - Shakespeare's *Pericles* (I, 1, 163) *My arrows,* *Too slightly timber'd for so loud a wind* *Would have reverted to my bow again,* *And not where I had aim'd them.* - Shakespeare's *Hamlet* (IV, 7, 21)

In conjunction with:	The students might:
ENGLISH LANGUAGE ARTS EDUCATION	• Use one of the following quotations as the basis for an essay or a short story:

God sendeth us good feathers, but the devil naughty fletchers.

- Ascham's *Toxophilus* (1545)

The man of God is better for having his bow and arrows about him.

- Old English saying (1659)

So the struck eagle, stretch'd upon the plain,
No more through rolling clouds to soar again,
View'd his own feather on the fatal dart,
And wing'd the shaft that quivered in his heart:
Keen were his pangs, but keener far to feel
He nursed the pinion which impell'd the steel.

- Byron's *English Bards and Scotch Reviewers* (1809)

• Write a brief research paper on a topic like the following:

Amenhotep III, Top Bow
Arrows Shot from Guns (1326)
Bows and Arrows in the Vietnamese War
Bows, Arrows, and Genghis Khan
The Cheshire Archers of Richard II
English Longbows
Henry VIII, Avid Archer
Legalized Bowhunting
Robin Hood, the Outlaw of Sherwood Forest
The Role of the Horse in the Development of Asian Archery
St. Hubert, Patron Saint of Bowhunters
State Archery Hunting Preserves — Where, When, and Why

ENVIRONMENTAL EDUCATION

• Debate the philosophy of deer management expressed in the following excerpt from *The Conservationist* (September - October 1976, pp. 18-19):

> The overall philosophy of deer management is two-fold: to maintain the greatest population of deer in the state that the range will properly support and that is compatible with the interests of farmers, orchardists, nurserymen and others, and to provide for the best use of this resource for the benefit of the people. As has been pointed out, maintenance of a healthy, thriving deer population requires that its numbers be held within the carrying capacity of its range, and the only effective means of doing this where overpopulation threatens is to reduce the number of females in addition to taking males. Under present conditions, in the absence of natural predators, such reduction must be done by man or it will be done by starvation or disease which will be attended by range deterioration through overbrowsing and ultimately by a general scarcity of deer. Furthermore, the deer that die will lie in the woods and rot. On the other hand, by harvesting the surplus through recreational hunting before an overbrowsing problem develops, the animals are not wasted, range quality is maintained and the deer population continues to thrive.
>
> - "The Philosophy of Deer Management," by C. W. Severinghaus and Robert W. Darrow

In conjunction with:	The students might:
ENVIRONMENTAL EDUCATION	• Invite a representative from the New York State Department of Environmental Conservation to present a program on a topic such as the following: . The need for wildlife management . The role of State government in maintaining an environmental balance which is favorable to the citizenry of the State . The impact of laws relative to game preserves, hunting seasons, licensure, etc. . The mandatory bowhunter education program
INDUSTRIAL ARTS EDUCATION	• Work with woods, metals, and fibers to develop an understanding of fabrication, construction, quality control, and structural stresses as they relate to bows and arrows. The design, construction, and *use* of any piece of equipment should be predicated on a knowledge of the structural limits and safe operating conditions of that equipment. Through their experiences in industrial arts, student archers should be able to identify potential splits and structural failures, and know something about the proper form, size, and condition of the materials needed for their equipment in terms of the stresses that will be placed upon it. • Make some of the items related to archery — not as a service to the physical education department, but as a source of personal satisfaction and a means of exploring career or avocational interests. • Develop new games or novelty events in archery, and design and/or make the equipment for them.
MATHEMATICS EDUCATION	• Convert American standard measurements for archery ranges and equipment to metric measurements. • Do a statistical study of the hits (as opposed to the scores) for X-number of ends. How many arrows hit the gold? the red? the blue? . . . How many hit (or missed) the target? Project trends and "guestimate" the number of arrows in the next end that will hit the target, the gold, the red, etc. Shoot the end and compare the actual results with the theoretical results. • Repeat the preceding activity several times and record the difference between the actual and the theoretical results in each case. Did *more* or *fewer* arrows hit the mark than were expected? Compute and chart the percentage of deviation for several ends. Does the reliability of the guestimate *in*crease or *de*crease over time? Identify possible reasons for the change. Look at the number of arrows which hit a given mark, or at the score for each end, and consider how, if at all, the anticipated outcomes may have affected the archer's performance. Test the hypothesis in subsequent ends. • Using data from the preceding activities, determine how many arrows hit the target, the gold, the red, etc., out of the total number shot. Compute the percentages, and calculate the probability that the next arrow will hit the target, the gold, the red, . . . • Record the number of students who participated/are participating in some aspect of the archery program (class, team, club, tournament, etc.) during this year, last year, and any other years for which the data are available. What percent of the total student population participated in each case? What percent of the *eligible* student population participated? Calculate the percent of increase or decrease from one year to another and graph the results. To what extent has the program prospered or deteriorated (net change)?

In conjunction with: The students might:

MATHEMATICS EDUCATION

- Contact the Hunter Education Program of the New York State Department of Environmental Conservation, Albany, NY 12233 and request the number of bowhunters that were licensed during the last calendar year and for each of the past 5 or 10 years. Calculate and chart the percent of increase per year and then, using the formula given below, determine the number of licensed bowhunters there are likely to be in New York State next year, the year after that, 5 to 10 years from now, etc.

$$B = B_b \times (1 + a)^n$$

B = the new bowhunter population
B_b = the number of bowhunters during the base year (in this case, last year)
a = the percent of growth or increase
n = the number of years projected for the problem (1, 2, 5, ...)

Repeat the activity with comparable information about gunhunters.

- Using data from the preceding activity, plus information about deer populations and the number of deer harvested by bowhunters and by gunhunters during the years identified above, write a computer program that will project the impact of bowhunting, or bowhunting and gunhunting on the deer populations of New York State next year, the year after that, etc. How is this impact being regulated?

SCIENCE EDUCATION

- Find Sagittarius (The Archer) on a star map and explore some of the following items:

  * What is a *constellation?*
  * How did constellations like Sagittarius derive their names?
  * Sagittarius is one of several "star pictures" that lie along a path that the sun, the moon, and the planets appear to follow through the sky. What are the names of the other constellations?
  * Why is Sagittarius visible (in the northern hemisphere) only during the late summer?
  * What is the *lagoon nebula* that forms a part of Sagittarius?

- Do projectile problems.

  * Given its initial speed, determine the angle at which an arrow should be aimed in order to strike the gold on a target 18 (25, 30, 40, 50) meters from the shooting line. What is its maximum range at that speed? What is the maximum height of its trajectory? How long will it take to hit the target? Repeat the problem with other initial speeds.

  * View the following filmloops — *Galilean Relativity I, Galilean Relativity II, Galilean Relativity III, Finding the Speed of a Rifle Bullet I, Finding the Speed of a Rifle Bullet II* — and then, given the draw weight of a bow and the length of an arrow, determine the initial speed of the arrow. (The filmloops were prepared for the Harvard Project Physics Program and are available from Holt, Rinehart and Winston, Inc., 383 Madison Avenue, New York, NY 10017).

  * Explore the Huntington Project's computer program for projectile motion and/or read Allen S. Rosen's "Computer Analysis of Projectile Motion" in *The Physics Teacher* (13:6:353-4, September 1975) and apply the information to the use of bow and arrow with stationary targets (as in target archery or clout shooting) and with moving targets (as in bowhunting or novelty games). Then, if possible, develop computer programs in these areas.

EXTRACLASS OPPORTUNITIES

The opportunity to compete is as important in archery as it is in any other sport. Competition can be encouraged in class, of course; but there should also be opportunities to compete in intramural and varsity programs as well. Winning in a sportsday is as satisfying to an archer as winning a basketball game is to the players — and it is especially valuable for students with handicapping conditions.

To keep both interest and effort high, attach meaningful rewards to some intermediary achievement goals. For example, when archers can successfully shoot five consecutive ends with scores over 45 at 18 meters, assign them a set of arrows for their exclusive use; when they can do the same thing at 25 meters, assign them a better bow. It is amazing how hard the students will work to have their own equipment with which to shoot.

Promote tournaments with nearby schools and run them well so that there is a real sense of achievement. Enter teams in tournaments sponsored by various groups in other parts of the State, and in the Mail Tournament co-sponsored by the National Association for Girls' and Women's Sports and the National Archery Association. The latter can be a real thrill and, since there are several opportunities to score during a designated period, the young archers will strive to shoot higher and higher scores. Finally, encourage your students to enter open tournaments. Who knows? The next Olympic Champion might be one of these!

An archery program enthusiastically conducted can give boys and girls alike a new sport with much carryover value. It is currently experiencing a great deal of popularity as a recreational activity; but it can also contribute to the students' knowledge of science and mathematics, their understanding of our space program, and the safety of the thousands of bowhunters now roaming the woods, for many of the underlying principles of target archery, missile technology, and bowhunting are the same. In any event, schools should provide specific instruction in archery (as opposed to offering the sport solely as an extraclass activity), for a nocked arrow is like a loaded gun — it should be treated with knowledge, skill, and respect.

Good Shooting!

A GLOSSARY OF TERMS

Anchor - to place the index finger of the string hand on a specific spot on the face, while aiming; usually, in target archery, under the jaw.

Anchor Point - the specific spot on the face where the index finger of the string hand is placed while the archer is aiming. This is comparable to the rear sight on a rifle.

Arrow Rest - a small projection attached to the top of the bow handle where the arrow rests while it is nocked on the string.

Back - the side of the bow away from the string.

Belly - the side of the bow nearest the string, now called the *face*.

Bow Arm or Hand - the arm or hand which holds the bow when the archer is shooting.

Bowstringer - a device used to brace the bow for shooting. Strongly recommended for all recurve bows.

Brace - to string the bow; to place the string in the proper position for shooting.

Brace Height - the distance from the pivot point to the string of a braced bow; also called *string height* or *fistmele*.

Butt - the backstop to which a target face is attached.

Cant - the direction in which the top of the bow is tilted.

Cast - the distance a bow can send an arrow.

Centershot Bow - a bow so made that the arrow, while on the rest, is in line with the centerline of the limbs.

Clicker - a small metal arm mounted on the sight window of the bow in front of the arrow rest that gives an indication of when the arrow is at full draw by snapping off the tip of the arrow with an audible click.

Clout - a white "flag" on a stake used as a marker for clout, or long-distance shooting.

Clout Shooting - a form of target shooting where the arrow is shot into the air from a distance of 120 to 180 yards (109.7 to 164.6 meters) at a 48-foot (14.6-meter) target laid out on the ground.

Creep - to allow the arrow to move forward slowly during the aiming step before the release.

Draw - to pull the bow string back; also, the act of pulling back the bow string in the process of shooting.

End - *(American)* six arrows, shot consecutively or in groups of three; *(English)* three arrows, shot consecutively.

Extend - to hold the bow with the nocked arrow toward the target before the draw.

Field Captain - the male official in charge of an archery tournament; his female counterpart is called *Lady Paramount*.

Finger Sling - a small strap that attaches to the thumb and index finger of the bow hand to prevent the bow from dropping on release.

Fletching - the feathers or plastic vanes attached to the arrow shaft to guide its flight.

Free Style - a method of shooting which incorporates the use of a bow sight to aid in aiming.

Grip - the part of the bow which is normally held in the hand while shooting.

Group - to shoot arrows closely together in a regular pattern.

Hen Feathers - the two feathers or vanes which are *not* at right angles to the slot in the arrow nock.

Index Feather - the feather or vane set at right angles to the nock; also called the *cock feather.*

Kisser Button - an indicator located on the bow string so that it touches the lips or teeth when the archer is at full draw.

Laminated Bow - a bow made with several layers of material glued together, usually two layers of fiberglass with a hardwood core.

Limb - the upper or lower part of the bow which bends as the string is drawn.

Matt - a circular disc of straw to which the target face is attached.

Nock - to place the arrow on the string; also, the attachment to the rear end of an arrow which is placed on the string to hold the arrow during the draw.

Nocking Point - the place on the string where the arrow is nocked; often marked with ink, thread, or a knot.

Nock Locator - the mark or device used to indicate where the arrow is nocked on the string.

Pivot Point - the point on the face side of the grip which is farthest from the string when the bow is braced.

Quiver - a device for holding arrows.

Rebound - an arrow which bounces off the scoring area of the target face.

Recurve - the end of the bow limb which bends away from the archer when the bow is held in shooting position.

Release - to allow the string to leave the fingers; also, that stage in the sequence of steps in shooting when the arrow is "released," or let fly.

Round - the shooting of a prescribed number of arrows at specific target faces from set distances.

Serving - the wrapped portion of the bow string where the fingers are placed to shoot.

Sight - a mechanical device placed on the bow to enable the archer to aim directly at the target.

Sight Window - the cut-out section of the bow above the grip.

Sling - a strap fastened to the bow or to the archer's bow hand in order to keep the bow from falling after the release. Same use as a finger sling.

Spine - the combination of stiffness and resilience in an arrow.

Stabilizer - any weight attached to the handle riser to minimize torque; usually a weight attached to a light rod extending forward.

String Alignment - the lining up of the string with either the sight or the sight window.

Tackle - a general term for archery equipment.

Take-down Bow - a bow which can be taken apart for storage or carrying convenience, and adapted to the needs of different archers by changing the limbs to form bows with different draw weights.

Target Captain - the person who is in charge of a target. S/he decides who is to call the value of each arrow, record the scores, and draw the arrows from the target.

Trajectory - the path of an arrow in flight.

Vane - a type of fletching, usually made from plastic.

SELECTED RESOURCE MATERIALS

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FILMS AND FILMSTRIPS

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Men's archery. Set 3-S8 mm. film loops. 4 min. each, silent, color. Hardy Ward, World's Archery Champion, demonstrates in regular and slow motion: 1. Stance, Nocking an Arrow; 2. Draw, Aim, and Hold; 3. Release and Follow Through. (1971) The Athletic Institute, 705 Merchandize Mart, Chicago, IL 61654.

1965 FITA World Championship Archery, Sweden and *1969 FITA World Championship Archery, Valley Forge, U.S.A.* Both 16 mm., 20 min., sd., color. Rental free. Excellent display of tournament archery at its best. Jas. D. Easton, Inc., 7800 Haskell Ave., Van Nuys, CA 91406.

A return to the Olympics. 16 mm., 20 min., sd., color. Rental free. Archery in the 1972 Olympic Games in Munich. Jas. D. Easton, Inc., 7800 Haskell Ave., Van Nuys, CA 91406.

Seven steps to gold. 16 mm., sd., color. Features John Williams, Olympic Gold Medal Winner in 1972. Detailed and excellent demonstration of good shooting form. Wing Archery Division, Rt. 1, Jacksonville, TX 75766.

Straight as an arrow. 16 mm., 20 min., sd., color. Rental free. Technical shots shown in slow motion photography. Jas. D. Easton, Inc., 7800 Haskell Ave., Van Nuys, CA 91406.

Women's archery. Set 3-S8 mm. film loops. 4 min. each, silent, color. Doreen Wilber, 1972 Olympic Gold Medal winner, demonstrates: 1. Stance, Nocking an Arrow; 2. Draw, Aim and Hold; 3. Release and Follow Through. The Athletic Institute, 705 Merchandize Mart, Chicago, IL 61654.

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In this study, subjects without previous experience in archery drawn from 40 freshman college women selected at random achieved performance scores in target archery that were (1) higher after twelve 60-minute periods of instruction shooting at small, rather than large scoring faces; (2) higher when practice involved shooting at small scoring faces, regardless of shooting technique or distance from the target; and (3) similar when practice involved variations in distance from the target *and* in shooting technique.

Beverley, Leah. *The effects of instant videotape feedback in learning target archery.* D. dissertation. University of Southern Mississippi, 1973.

This study involving 90 female volunteers from three beginning archery classes at Glassboro State College revealed that (1) lecture/demonstration, a standard method of college instruction, significantly improved motor skill performance and form in target archery; (2) lecture/demonstration reinforced by videotape recordings made of each subject shooting three arrows and then played back for observation, analysis, and correction was superior to lecture/demonstration alone as a means of improving both skill and form; and (3) videotape instant feedback during *every* class period did not produce significantly more improvement in motor skill performance than video replay during alternate periods, but it did produce significantly greater improvement in form.

Harrison, J. M. *A comparison of a videotape program and a teacher-directed program of instruction in teaching the identification of archery errors.* D. dissertation. Brigham Young University, 1973.

This comparison study involved four groups of students majoring in physical education — two from archery classes, and two from classes other than archery. One group from each pair received instruction in a particular unit via videotape; the other received teacher-directed instruction. Among other things, the study revealed that (1) students from archery and non-archery classes who received instruction via videotape learned significantly more than teacher-directed archery students at the .001 level of confidence; and (2) there was no significant difference between the learning achieved by archery students and that achieved by non-archery students when both received instruction via videotape.

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Khouri, L. M. *Archery for the visually handicapped.* M. thesis. Women's College, University of North Carolina, 1961.

Malmud, N. R. B. *The effect of knowledge of specific performance standards for grade achievement on the archery performance of community college students.* D. dissertation. New York University, 1974.

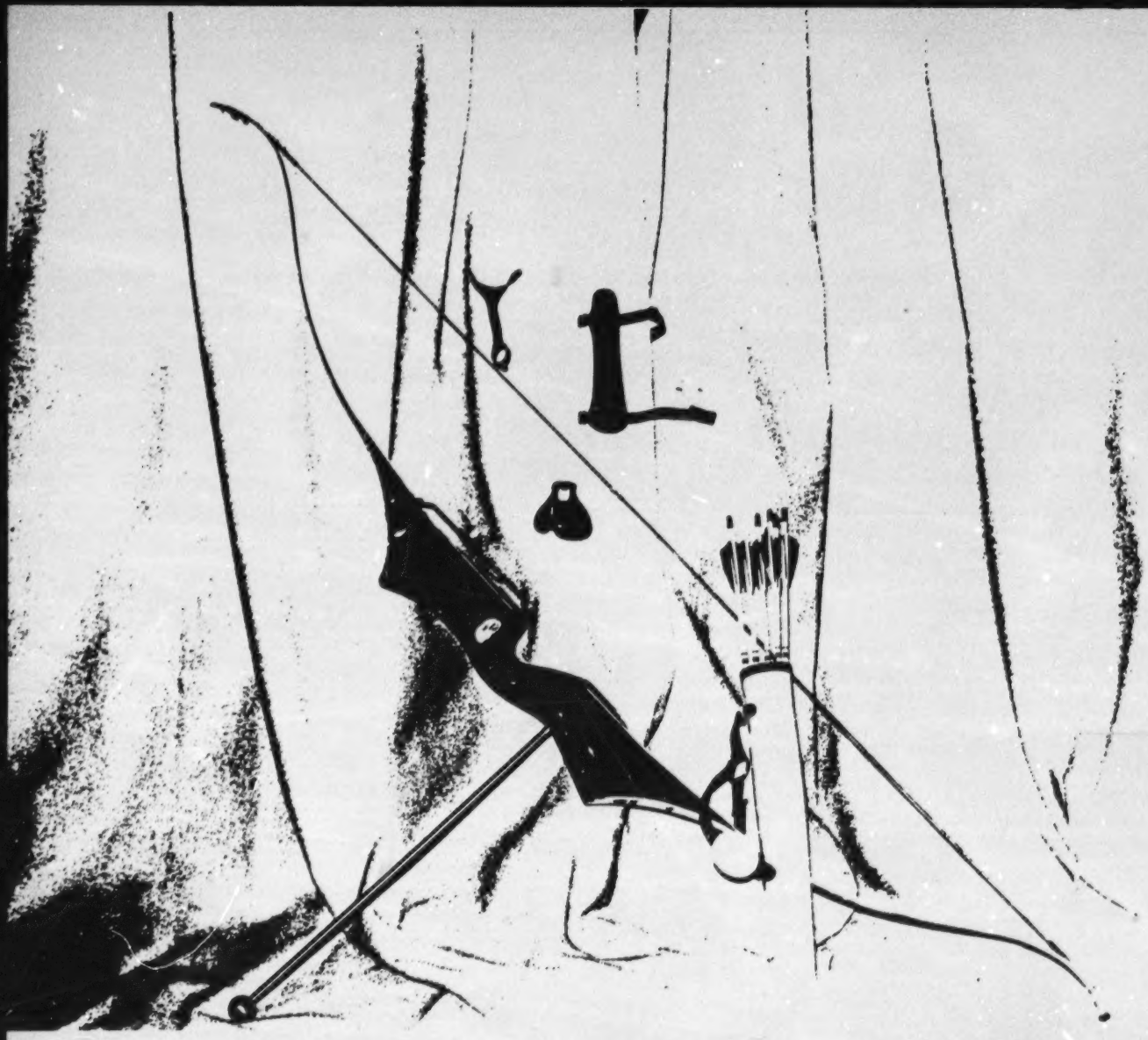
The study included all students in each of 16 archery courses given in the required physical education program at Nassau Community College during the spring semester, 1973. Although statistically significant for male, but not for female subjects, the results indicated that knowledge of specific performance standards *can* result in improved motor performance in archery.

Moore, S. L. *The effect of homogeneous and heterogeneous grouping on motor skill learning of college women in elementary archery.* M. thesis. University of Oregon, 1966.

Ulrich, R. P. *The effect of hypnotic and nonhypnotic suggestions on archery performance.* D. dissertation. University of Utah, 1973.

Designed to investigate and compare the effects of suggestions given in a hypnotic state with those given in a waking state on archery performance, the study revealed that suggestions given in the waking state were equally and sometimes more effective than identical suggestions given in a hypnotic state.

TEACHER'S NOTES



COVER CREDITS

Time-lapse art by Jim Butcher tracing the paths of Earth and Mars during the 11 months it took for the Viking to travel between the two planets

and

An artist's rendition of Mariner 10, the first spacecraft to use the gravity of one planet to reach another

— National Aeronautics and Space Administration

Heracles drawing his bow against the Stymphalian Birds (Bourdelle, 1909)

— The Metropolitan Museum of Art

Gift of Mr. and Mrs. Stephen C. Millett, 1924

Cover design — Kenneth W. Hoare